

DELHI METRO RAIL CORPORATION LTD.

Contract- CC-100

Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

SUMMARY SHEET (ADDENDUM NO-1)

S. No.	Tender Document	Page No.	Clause No./ Item No.	Addendum/ Corrigendum
1.	Technical Specifications-Annexures	01	Annexure 'A' to Technical Specifications (01 Page)	New Annexure incorporated
2.	Technical Specifications-Annexures	02	Annexure 'B' to Technical Specifications (02 pages)	New Annexure incorporated
3.	Technical Specifications-Annexures	04	Annexure 'C' to Technical Specifications (06 pages)	New Annexure incorporated
4.	Technical Specifications-Annexures	10	Annexure 'D' to Technical Specifications (12 pages)	New Annexure incorporated
5.	Technical Specifications-Annexures	22	Annexure 'E' to Technical Specifications (01 page)	New Annexure incorporated
6.	Technical Specifications-Annexures	23	Annexure 'F' to Technical Specifications (06 pages)	New Annexure incorporated
7.	Technical Specifications-Annexures	29	Annexure 'G' to Technical Specifications (03 pages)	New Annexure incorporated

Annexure – ‘A’ to Technical Specifications Measuring Protective Coatings in Accordance with SSPC-PA2

Coating thickness measurement is of growing importance in the paint and corrosion protection industry, as is conformance to regulations and standards like SSPC-PA2, a specification that describes procedures to measure the thickness of a dry film (DFT).

As the useful life expectancies for structures such as bridges, ships, pipelines and water tanks have increased detailed inspections during or after the paint application process have become the norm. SSPC-PA2 provides a uniform way for industrial painting contractors, facility owners and third party inspectors to evaluate these coating projects.

According to SSPC-PA2, a gauge measurement is a single instrument reading, spot measurements are typically the mean of three gauge measurements within a 4 cm (1.5 inch) diameter circle, and area results may comprise the mean of five spot measurements. The frequency of measurements is determined by the size of the structure: If less than 300 square feet (~28 m²), a measurement is taken every 100 square feet (~10 m²). If the structure is between 300 and 1000 square feet (~28 and 100 m²), one arbitrarily selects three random test areas of 100 square feet (~10 m²) and measures.

All handheld gauges comply with SSPC-PA2. Even the entry level MP0 Series quickly calculates spot mean values. Standard units such as the MPOR have the built in specification to automatically sequence spot mean values while simultaneously monitoring the minimum and maximum readings. In addition, the user is alerted if spot measurements are less than 80% or more than 120% of the specified thickness. A complete inspection plan with images can be created to guide the user to the location of each measurement.

Selecting the appropriate probe for the application greatly enhances adherence to tolerances, either with integrated probes or gauges able to accommodate multiple separate probes designed for specific measurement challenges.

Annexure – ‘B’ to Technical Specifications

3.15.4 GUN METAL BALL VALVE

The ball valve shall be made Gun Metal and suitable for test pressure of pipe line. The valve shall be internally threaded to receive pipe connections.

The ball shall be made from Gun Metal and machined to perfect round shape. The seat of the valve body-bonnet gasket and gland packing shall be of Teflon.

The handle shall be provided with PVC jacket. The handle shall also indicate the direction of ‘open’ and ‘closed’ situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping.

The handle shall also be provided with a lug to keep the movement of the ball valve within 90°. The lever shall be operated smoothly and without application of any unnecessary force.

3.15.5 BUTTERFLY VALVE

The butterfly valve shall be DI/ CI suitable for waterworks and rated for 300 P.S.I

The body shall be of IS: 210 in circular shape and of high strength to take the water pressure. The disc shall be anti-corrosive epoxy or nickel coating.

The valve seat shall be of high grade elastomer or nitrile rubber. The valve in closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be EN 8 grade carbon steel.

The valve shall be fitted between two flanges on either side of pipe flanges. The valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakages.

3.15.6 AIR RELEASE VALVE

Air valves are the most efficient and most cost effective tools for air control in pressurized liquid conveyance systems. Air valves in general are often misnamed as “Air release valves” or, less frequently, as “Vacuum breakers”. Actually, there are three basic types of air valves that function differently and serve different objectives.

- The Large Orifice Air Valve is usually called a “Kinetic Air Valve” in Europe and other parts of the world, and an “Air/Vacuum Valve” in the United States and North America. This type of air valve discharges large quantities of air from the pipeline at pipe filling and admits large quantities of air at pipe drainage (planned or due to rupture) or at water column separation. This air valve closes when the pipe fills up with liquid, and does not reopen until pressure within the air valve (pipeline) drops below atmospheric pressure.
- The Small Orifice Air Valve is usually called an “Automatic Air Valve” in Europe and other parts of the world, and an “Air Release Valve” in the United States and North America. This air valve continues to release small quantities of air when the system is pressurized and the Large Orifice Air Valves do not function.
- The Double Orifice or Combination Air Valve, includes two components, and performs the functions of the two types of air valves above.

Within the three categories of air valve types above, there are a variety of different models with a variety of additional accessories and attributes. One of the most important recent enhancements in air valve design is the non-slam, surge suppressing air valve.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Janna Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

MATERIALS

- A. Bodies and Covers: shall be of cast iron (ASTM A126, Class B, or ASTM A48, Class 35) or ductile iron (ASTM A536, Grade 65-45-12). Cover Bolts and nuts shall be stainless steel.
- B. Valve Connections: Flanged-end dimensions and drilling for cast-iron bodies and covers shall conform with ASME B16.1, Class 125 or Class 250. Flanged-end dimensions and drilling for ductile-iron bodies and covers shall conform to ASME B16.42, Class 150 or Class 300. Flanges shall be flat-faced unless otherwise specified by the purchaser. Threaded-end connections shall conform to the requirements for tapered pipe threads for general use, per ASME B1.20.1.
- C. Floats: Float balls and guides shall be stainless steel. For valves with inlet sizes less than 4 inches, the float shall be capable of withstanding a collapse pressure of 1,000 psig. For valves with inlet sizes 4 inches and larger, the float shall be capable of withstanding collapse pressures of 750 psig.
- D. Venting: Air release valves and the air release mechanism of combination valves shall be designed to open positively and vent air to the atmosphere at system pressures up to the maximum working pressure. Orifices shall be sized accordingly. The vent pipe shall be continuous from the valve to 2 ft (minimum) above finished grade and shall be provided with a #14 mesh screened, downward-facing elbow.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

Annexure – 'C' to Technical Specifications

4 TECHNICAL SPECIFICATION FOR HORIZONTAL CENTRIFUGAL PUMPS

4.1 SCOPE

This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.

4.2 CODES AND STANDARDS

The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

4.2.1 List of Applicable Standards.

- IS : 1520 Horizontal Centrifugal Pumps for clear cold fresh water.
- IS : 5120 Technical requirements of roto dynamic special purpose pumps.
- API : 610 Centrifugal pumps for general refinery service.
- IS : 5639 Pumps Handling Chemicals & corrosion liquids.
- IS : 5659 Pumps for process water.
- HIS Hydraulic Institute Standards, USA
- ASTM-1-165-65 Standards Methods for Liquid Penetration inspection.

In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

4.3 DESIGN REQUIREMENTS

- The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve over the operating range of 40% to 120% of the duty point. The maximum efficiency of pump shall be preferably be within +/- 10% of the rated design flow as indicated in the data sheets.
- The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of 15% more than the design head.
- Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.
- Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

SPEED	Antifriction Bearing	Sleeve Bearing
1500 rpm and below	75.0 micron	75.0 micron

- The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment.
- The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.
- The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).
- Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.
- The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.

4.4 DESIGN CONSTRUCTION

Design and construction of various components of the pumps shall conform to the following general specifications. for material of construction of the components, data sheets shall be referred to.

4.4.1 Pump Casing

Pump casing shall have axially or radially split type construction. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.

Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

4.4.2 Impeller

Impeller shall be closed, semi-closed or open type, and it shall be designed in conformance with the detailed analysis of the liquid being handled.

The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

4.4.3 Impeller/Casing Wearing Rings

Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.

4.4.4 Shaft

The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.

The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.

4.4.5 Shaft Sleeves

Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.

Shaft sleeve shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

4.4.6 Bearings

Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished

The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.

Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

4.4.7 Stuffing Boxes

Stuffing box design should permit replacement of packing without removing any part other than the gland.

Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.

4.4.8 Mechanical Seals

Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.

The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.

4.4.9 Pump Shaft Motor Shaft Coupling

The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

4.4.10 Base Plate

A common base plate mounting both for the pump and motor shall be provided. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.

4.4.11 Assembly and Dismantling

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

4.4.12 Drive Motor (Prime Mover)

The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps are specified, the actual motor rating is to be selected by the tenderer considering overloading of the pumps in the event of tripping of operating pumps.

4.5 TESTING FOR HORIZONTAL CENTRIFUGAL PUMPS

The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with the requirement of applicable Codes and Standards. The particulars of the proposed tests shall be submitted to the Owner for approval before conducting the tests.

4.5.1 Hydrostatic Tests

All pressure parts shall be hydraulically tested at 200% of pump rated head or at 150% shut off head whichever is higher. The test pressure shall be maintained for 1/2 hr. and no leakage shall be permitted. While arriving at the above pressure, the maximum suction head specified in Data Sheet shall be taken into account.

4.5.2 Performance Tests

All the pumps shall be tested in the Manufacture's Works at rated speed for capacity, efficiency and brake horse power. Pumps shall be given running test over the entire operating range covering from the shut off head to the maximum flow. The duration of test shall be minimum one (1) hour. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standards or as applicable equivalent

The test shall be preferably conducted with the actual motor being furnished.

Only those pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and excessive vibration is observed during the performance test. Otherwise strip down examination is limited to bearing inspection only.

The pump accessories e.g. the thrust bearing, couplings etc. shall be subjected to tests as per manufacturer's standards.

4.5.3 Mechanical Balancing

All rotating components of the pumps shall be statically balanced. In addition to static balancing, rotating components of the pumps shall be balanced dynamically at or near the operating speed.

Tenderer shall furnish acceptance norm for this test.

4.5.4 Visual Inspection

Pumps shall be offered for visual inspection by the bidder before shipment. The components of the pumps shall not be painted before inspection.

4.5.5 NPSH Test

NPSH test shall be conducted with water as medium if required. NPSH shall not be mandatory in case type test certificates are furnished for the similar rating of pumps.

4.5.6 Noise and Vibration Measurement

Noise and vibration shall be measured during the performance testing at shop as well as during the site test.

The noise level shall not exceed 85 dBA. Noise level measurement will be made as per applicable internationally acceptable standard. The measurement shall be carried out with calibrated integrating sound level meter meeting the requirement of IEC:651 or BS:5969 or IS:9779. Sound pressure level will be measured all round the pump and motor set at a distance of one meter from the nearest surface of the machine and at a height of 1.5 m from the floor level. A minimum of six (6) points should be covered for measurement. The measurement shall be done with a slow response on the A-weighted scale. The average of the A-Weighted sound pressure measurements expressed in decibels to a reference 0.0002 microbars shall not exceed the specified value.

The tests shall be carried out on the machine operating at rated speed and as near as possible to the rated power. Corrections for background noise and correction on account of test environment will be considered in line with applicable standard. For this purpose all the additional data required should necessarily be collected during the test.

Vibration check will also be done as per HIS. Vibration would be checked at thrust bearing locations on horizontal, radial and vertical direction. The acceptance limits would be as per HIS.

The instrument used would be IRD 308 or equivalent with velocity pick-up. Vibration limits to be specified as per the speed of the pump.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

4.5.7 Material Test Certificate

Material of the various pump components shall be tested in accordance with the relevant standards. Test certificates for these shall be furnished for the Owner's approval.

Where stage inspection is desired by BHEL/customer all material test certificates shall be correlated and verified with the actual material used for construction before starting fabrication by BHEL/customer's inspector who will stamp the material. In case mill test certificate for the material are not available, the supplier shall carry out physical and chemical tests at his own cost from a testing agency, approved by BHEL/Customer, as per the requirement of specified material standard. The sample for physical and chemical testing shall be drawn up in presence of BHEL/Customer's inspector who shall also witness the testing.

4.5.8 Non Destructive Testing

- (a) UT shall be carried out on shafts of diameter more than 50 mm.
- (b) DP tests shall be carried out on shaft and impeller.
- (c) No weld repair shall be allowed on cast iron.

4.5.9 Field Testing

After installation, the pumps offered shall be operated to prove satisfactory performance as individual equipment as well as a system run. If the performance at site is found not to the requirements then the equipment shall be rectified or replaced by the Vendor, at no extra cost to the Owner. The procedure of the above testing will be mutually agreed between the Owner and the contractor. Noise and vibration tests shall also be repeated at site.

Based on observation of the trial operation, if modifications and repairs are necessary, the same shall be carried out by the contractor to the full satisfaction of the engineer and then the performance and guarantee tests to be repeated at site as per relevant clauses of the specification.

Annexure – ‘D’ to Technical Specifications

5 Specifications for Diesel Generator Set

The specification describes requirements for the supply, installation, testing and commissioning of silent type diesel generator set, including necessary switchgear, control, fuel system, cooling system, fuel piping, silencer and exhaust piping and all accessories complete in all respects to meet the electric load of pumps and electrical appliances for water supply arrangements. DG set is to be located outdoor near to the pump house as per Engineer’s directions.

All equipment and materials supplied shall comply with the latest IS/ BS/ IEC Standards, in all respects with regard to design, construction, performance and tests as a minimum requirement. These shall comprise of first quality standard series or lines or products from manufacturers regularly manufacturing diesel generators. All equipment supplied shall be fully tropicalized system. The equipment supplied and installed shall result in minimum noise emission and pollution.

5.1 Power Output

Each installation shall comprise of an independent unit of diesel engine directly coupled to a 3-phase alternator together with the ancillary equipment as described and shall be capable of maintaining a continuous output at 0.8 lagging power factor of a 3 - phase, 4 wire, 400 volts, 50 Hz supply under specified operating conditions and within guaranteed maximum range of frequency and voltage regulation.

5.2 Ancillary Equipment

In addition to diesel engine and the brush less alternator, the installation shall include all ancillary works and equipment necessary for a self-completed power generating system. The ancillary shall include:

- a) Exciter for alternator
- b) Starting and stopping equipment for manual operation
- c) Engine cooling equipment (radiator cooling water system), valves and pump, radiator fan and canvas air duct
- d) Lubricating equipment system
- e) Exhaust piping (duly insulated and cladded), flexible connector and silencer
- f) Fuel servicing piping, control valves and service fuel tank
- g) Engine control equipment complete with tachometer, lubricating oil pressure, temperature alarm and automatic shutdown and other instruments
- h) Electrical starting system with batteries and battery charger
- i) Electrical control switchboard complete with instruments, switchgear, contactor, control cables and power cables
- j) Engine electrical system with 12 volts DC battery supply
- k) Anti-vibration mountings
- l) Acoustically treated enclosure for the generating set

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

5.3 Mounting

The engine, alternator and exciter shall be factory assembled on a common base frame which in turn shall be mounted on a main frame through resilient mountings. The concrete plinth shall be provided by the Contractor as required. The Contractor shall take all precautions to prevent the transmission of vibrations from the generator to the surrounding structure with adequate vibration control arrangement.

The Contractor shall also check the site to make sure that the provision of opening for cooling and ventilation of the installation is satisfactory.

5.4 TESTS AT MANUFACTURER'S WORKS

All equipment shall be tested at the manufacturer's works. The engine shall be tested in accordance with relevant IS/ IEC / BS standard and alternator, exciter in accordance with BS 2613.

Arrangements shall be made such that the Engineer shall (if so desired) be able to attend the tests at manufacturer's works. Certified records of each test performed shall be submitted for the Generator System and approved by the Engineer. The testing programme and procedure shall be approved by the Engineer before starting the test.

5.5 Spare Parts

The Contractor shall supply a schedule of essential spare parts recommended by the manufacturer. The schedule shall list clearly the unit price for each item delivered to site. The spare parts schedule shall be graded in number of years requirement or in number of hours running requirement. The contractor shall supply the essential spare parts approved by the Engineer.

5.6 Accessories and Special Tools

The Contractor shall supply and deliver free of cost a complete set of the essential accessories and special tools required to be held for use in servicing, adjusting or repairing the equipment supplied under this contract. The items to be provided shall be clearly listed in a schedule to be submitted together with spare parts schedule by the Contractor.

The accessories and special tools shall be supplied in the form of a complete kit and shall be contained in a well-constructed and compartmentalized tool box.

5.7 Engine and Fuel System

◀ Engine Type

The engine shall be multi-cylinder, heavy duty, turbo charged fuel injection, water cooled, instant starting, four stroke, designed to supply continuously the motive power required by the brushless alternator at the correct speed for generation of the specified output power within 30 seconds and under the specified conditions.

◀ Fuel

Fuel oil system shall be complete with all equipment, components and accessories. It shall comprise a pump fed fuel system, service tank, duplex filters, fuel pumps, injectors, necessary piping works and valves. Fuel pump shall be of positive displacement type suitable for characteristics of fuel oil specified. The engine shall be capable of meeting all the specified requirements while operating on "Class A" fuel to BS 2869. Fuel storage tank shall be provided

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

for the diesel engine. The fuel storage tank shall have a capacity of at least 8 hours continuous running on full load.

In addition, the fuel storage for 120 hours of generating set shall be provided with necessary pumping and steel piping arrangement as per direction of the Engineer.

↳ **Engine Governing**

Governing of the engine shall be in accordance with BS 5514 "Class A". Hand operated speed regulating gear shall be fitted to enable the speed of the set to be varied by 5% up or down from the normal while the engine is running.

Maximum change of speed on load variation:

- On sudden taking off or throwing 'ON' the rated load, temporary change of max 10% of rated speed.
- On change of load by any step of 20% of rated load, temporary change of maximum 3% of the rated speed.

↳ **Engine Exhaust**

Each engine shall be provided with a suitable exhaust system, to carry exhaust gases from the engine and dissipate them to the atmosphere in an approved manner as per directions of the Engineer.

The exhaust piping and fitting shall be suitably dimensioned to permit the free passage of the gases under all conditions of operating without adverse effect on the performance of the engine. The piping and fittings shall have a minimum thickness of 5 mm and shall be suitably protected from corrosion. Approved type flexible connections shall be made between the section of piping fixed to the engine and the piping fixed to the building structure.

The exhaust system shall incorporate a silencer capable of reducing the exhaust noises of the engine to an acceptable maximum 85 dB.

The silencer and all exhaust piping within the building shall be insulated with 38 mm thick moulded section of approved type-high temperature refractory insulation, white cotton canvas rope and finished with aluminum sheet neatly.

The outlet of the exhaust shall be arranged to ensure that exhaust gases are expelled clear of the building. Provision shall be made to prevent the entry of rain or birds into the exhaust system at all times. Outside piping shall be painted as directed.

Suitable condensate removal plugs or rocks shall be provided at all low points in the system.

↳ **Engine Cooling System**

The engine shall be cooled by closed circuit water - cooling system incorporating a fan cooled tropical duty radiator. The cooling system shall be capable of maintaining the rate of heat removal required for the proper operation of the engine under the specified condition. Temperature gauges shall be provided to display the lubrication oil cooling system temperature.

↳ **Engine Filters**

The engine shall be fitted with the following filters, each of the type and capacity most suitable for its application and of the best quality

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

- a) Air intake filters
- b) Duplex fuel filters
- c) Duplex full – flow strainers and filters for lubricating oil

◀ **Engine Starting**

Diesel engine of the generator system shall be provided with electric self-starter complete with a charging and control gear. All materials and equipment shall be of top quality and subject to IS/ IEC / BS Standard or equivalent standard. All electrical connections between systems shall be provided.

◀ **Fuel Supply**

The Contractor shall provide a fuel tank for the generator and install the extension oil pipe from the fuel tank.

◀ **Engine Electrical System**

The engine electrical system shall be operated with 12 V DC system as required for efficient and smooth operation. Batteries to suit the system shall be provided. Batteries shall be selected to withstand all climatic or environmental conditions of the site. The battery shall be provided with a main operated trickle charger with adequate charging capacity to suit the engine model and size. Necessary interlocks shall also be provided.

◀ **Instruments**

The instruments provided on the diesel engine shall include the following:

- a) Lubricant oil pressure gauge
- b) Tachometer
- c) Elapsed hour counter
- d) Cooling water thermometer on outlet from engine
- e) Cooling water thermometer on inlet to engine
- f) Lubricating oil thermometer on outlet from engine
- g) Lubricating oil thermometer on inlet from engine
- h) Cooling water thermometer on inlet to lubricating oil (if water-cooled)
- i) Exhaust gas thermometer

◀ **Protective Devices**

The equipment shall be supplied to provide warning and / or automatic shut down under the following conditions:

- a) Low lube oil pressure shut down
- b) High jacket water temperature shut-down
- c) Failure to start shut-down
- d) Over-speed shut-down

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

The low lube oil pressure warning and shutdown as well as the high temperature warning and shutdown devices shall be set at different pressure / temperatures as recommended by the manufacturers. The "Failure to Start" and shutdown warning shall operate if the engine should fail to start within adjustable pre-set time and shall automatically stop the automatic starting cycle to avoid excessive depletion of the batteries.

Under any of the above conditions, a common alarm bell and the appropriate warning light (amber) on the control panel shall operate. Operation of push button shall silence the bell. Reset facilities shall be provided so that after a fault or abnormal condition has been rectified the circuit can be restored to its normal condition.

5.8 Alternator and Electrical System

◀ Alternator and Exciter

The brushless alternator and exciter shall comply in all respects with BS 2613, BS 4999, BS 5000, IEC 34, BS 5514, ISO 3046, DIN 6271 or equivalent IS Standard. Insulation shall conform to BS 2757'E' or equivalent IS.

The rotor or armature shall be in mechanical and electrical balance upto 125% of the rated speed.

The stator shall be wound for three phase star connection with phases and neutral brought out to a terminal box mounted on the side of the alternator. The output terminal shall be marked in accordance with BS 822. Damper windings shall be provided in the pole faces.

The alternator and exciter shall be continuously rated at not less than the full engine output and shall be capable of carrying without injury a sustained overload of 10% current at full rated voltage for one hour after having attained a temperature rise corresponding to its rated load under the specified site conditions.

◀ Voltage Regulation

The voltage regulation shall be within ± 2.5 % from no load to full load and inclusive of a speed variation of ± 4.5 %.

The voltage regulation system shall include the following:

- a) An automatic voltage regulator complete with voltage adjusting rheostat and accessories
- b) Manual voltage control by means of an exciter shunt field regulator or other approved means
- c) Selector switch for automatic / manual operation
- d) Alternator field switch and field discharge resistor
- e) All necessary current transformers, voltage transformers and control devices

◀ Voltage Waveform

The voltage waveform shall approximate be as close as possible to a sine wave both at no load and at full load with a lagging power factor of 0.8 and shall not exceed the limits as stated in BS 2613, Section 3.

◀ Accessories

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

a) Engine Accessories

- i. Speed governor
- ii. Over speed trip mechanism
- iii. Hours run meter
- iv. Lubricating oil pump
- v. Oil pressure gauge and lower pressure switch
- vi. Cooling water system
- vii. Oil and water thermometer
- viii. Exhaust piping system and silencers
- ix. Alarm system

b) Rating and characteristics

Normal power	:	160 KVA (at 0.8 PF)
Type	:	Direct Injection
Charging	:	Turbo charged
Starting	:	12 V Battery

c) Fuel storage Tank

- 120 hours continuous operations at 80% load without refueling
- Made out of sheet steel
- Fabricated with necessary access, extension collar and opening for piping and other accessories
- Connections to tank welded (Gas and watertight)
- Tank accesses –Bolted over type gasket for air and water tightness
- Oil piping – Black steel or galvanized steel extended 100 mm into the tank, positive displacement pump, with fully enclosed motor all conforming to international fire protection standards.

5.9 Site Testing

< General

Site testing shall comply with the following requirements

Before the commencement of acceptance testing, the Contractor shall have brought the installation to a state of practical completion and shall have completed all of the preliminary testing and adjusted the equipment to its proper operating order.

The Contractor shall have given the Engineer a full seven (7) days' notice of his readiness for carrying out acceptance tests.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

Prior to the date of giving such notice, the Contractor shall submit a complete and detailed schedule of the tests to be carried out to the Engineer for his approval and shall make such alterations and additions to the schedule as may be required.

Notwithstanding his approval of the testing schedule, the Engineer may at any time before or during the testing period instruct the Contractor to carry out any further tests he considers necessary.

◀ **Testing Period**

On receiving notice from the Contractor of his readiness for acceptance testing, the Engineer will set aside and designate a period for the carrying out of acceptance tests. During this period, no modification, adjustments or other work on the installation shall be done without the express permission of the Engineer in each case. Should there be any contravention of this requirement, the Engineer may reject the results of all tests completed and order a re-commencement of the testing programme.

◀ **Testing Programme**

The Contractor shall prepare a detailed day-to-day programme of testing for approval by the Engineer, including all measures necessary to ensure that testing proceeds as much as possible in accordance with this programme.

◀ **Supervising of Test**

No acceptance tests shall be carried out except in the presence of the Engineer and the Contractor or their authorized representatives appointed for the purpose.

◀ **Material for Testing**

a) General

- i. The Contractor shall provide at his own cost all materials, including electric power, fuel, lubricants and other consumables, required for carrying out the testing and adjustment of the equipment and for carrying out the acceptance tests and any re-tests that may be necessitated by the failure of the installation or by any other causes.

The Contractor shall ensure that the fuel supplied for use in acceptance tests is part of a batch for which certified test date is available. Two copies of the test certificate shall be supplied to the Engineer prior to the commencement of tests.

- ii. During the testing period, the Contractor shall be available on site and make available all items of testing, checking, detecting and measuring equipment necessary or desirable for the checking, adjustment and testing of test equipment for checking the accuracy of gauges and instruments forming part of, or supplied with, the installation.

Engineer may from time to time before or during the testing period instruct the Contractor to provide more equipment considered necessary and contractor is to comply with the same.

b) Preliminary Tests and adjustment (Engine)

- i. The crankshaft alignment shall be checked when the engine is cold.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

- ii. The exhaust temperature at normal full load shall be taken. This temperature shall be within plus or minus 15° F of the maker's standard exhaust temperature for full load when the adjustments of compression and firing temperature have been made.
- iii. Test providing the satisfactory performance of all safety controls shall be carried out. Governor trial shall be carried out as laid down in BS 649. If the governor performance does not come within the prescribed limits, the Contractor shall make the necessary adjustments and repeat the governor trial until a satisfactory result is obtained.
- iv. All fuels, lubricating oil, testing equipment and other sundries necessary in carrying out the tests as required under this specification herein shall be deemed to have been included for in the tender price.

◀ Preliminary tests and Adjustments (Electrical)

The preliminary electrical tests required to be carried out by Contractor shall include the following:

a) Insulation resistance

- Stators, rotor and exciter windings to earth
- Stator - between windings

◀ The schedule of tests to be performed shall include the following

Series 1

Three separate days and before any other operation of the diesel generator on that day, three successful manual start-up operations to be accomplished.

Series 2

The manual start-up operation within one minute of the diesel generator being shut down after running continuously for not less than one hour and attaining normal engine running temperatures.

Series 3

The automatic shut-down operations, initiated by mechanical simulation of a "low pressure" condition.

Series 4

The automatic shut-down operations, initiated by manual instigation of an "over-speed" condition.

Series 5

The abortive start-up operations, inducing "failure to start" shut-down.

Series 6

Three complete cycles of operation, including start-up and manual shut-down and a minimum of one hour's operation under the following load conditions:

- a) One cycle with the full specified load (where full load is not available, the Contractor shall provide a resistor band equal for full load test). The load shall be suitable for application in steps.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

- b) One cycle with 10% overload, after running on load wherein engine and alternator have attained the temperature corresponding to rated load under site conditions. This test shall be conducted within 3 minutes of a previous operation of at least one hour on full load.
- c) One cycle with the load varied at the discretion of the Engineer but not exceeding the specified maximum load.

At the completion of the test, readings shall be taken of the following:

- Insulation resistance – rotor, stator, exciter to earth
- Insulation resistance – between stator windings
- Alternator rotor and exciter armature temperature

After the load run, all inspection doors shall be removed from the engine, the running gear examined and all nuts checked for tightness.

Series 7

Such further tests as are reasonable to determine the compliance with specified requirements of controls, warning signals and other equipment not otherwise tested.

↖ **Temperature Measurements**

Temperature measurements for the alternator during the trials shall be carried out in accordance with requirement of Clause 76 of BS 2613.

↖ **Combined Test**

Where feasible, two or more individual tests may be combined or made immediately and consecutively.

A record shall be kept of the readings of all fixed and temporary instruments and gauges immediately, before and after each "running" test and at reasonable intervals (in proportion to its duration) during each test. The record of readings shall be taken at intervals of 30 minutes. The ambient temperature and other relevant data shall also be recorded in each case.

Test reports shall be prepared and submitted to the Engineer pertaining to each test for approval and acceptance.

↖ **Re-performance of Tests**

Should one or more of any series of tests result in the failure of the installation or any part of it to perform in accordance with the requirements of the Specification, the installation shall be deemed to have failed on initial testing in that respect. The Contractor may then request the Engineer to amend the testing programme to allow time then or later for modifications or adjustments to the installation to overcome the defect.

The Engineer will make such alterations to the testing programme as is reasonable for this purpose and the unsuccessful test series shall be re-performed after the modifications and adjustments have been made. The Engineer, at his discretion, shall order the required re-performance of all or any of the other tests that were carried out prior to the making of modification and adjustments.

↖ **Further Re-tests**

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

Should the installation again fail to perform in accordance with the requirement of the specification during the first or any further performance of any series tests, the granting of permission to make further modifications and adjustments and to make further re-tests shall be entirely at the discretion of the Engineer. Should any of the series of tests result in failure of the installation, in full or in part, to perform in accordance with the requirements of the specification and should this failure be of a minor nature only and no other faults be evident, the Engineer may, at his discretion and taking into consideration the results of the other tests of the series and of other series, accept the overall result of the series of tests as being successful.

◀ **Performance Failure**

Should the installation fail to perform in accordance with the requirements of the specification during the first or any further re-performance of any series of tests, installation will be deemed to have failed on test and the whole or any part of it rejected.

◀ **Structural or Mechanical Failure**

If during the course of testing any evidence of structural or mechanical failure of any of the installation should become apparent, the Engineer, may at his discretion permit the Contractor to carry out rectification or modification and re-testing generally in accordance with the provisions of the Clause. "Re-performance of tests" but with the full cost of all re-tests, including the first, being borne by the Contractor.

Should the Engineer consider any structural or mechanical fault or failure to be such that on site rectification or modification would not be desirable or that such fault reveals an undesirable inherent defect of design, or should a fault or failure occur after rectification or modification, he may reject the whole or any part of the installation.

◀ **Extension of Testing Period**

No extension of the testing period, which shall form part of the contract period shall be granted by reason of any extension of the testing period to permit rectification, modification, adjustment or retesting of the installation except where testing has been delayed or retesting or further testing has been necessitated by circumstances outside the control of the Contractor.

5.10 Painting and Finishes

The whole of the equipment and material supplied and installed shall be painted by the Contractor in accordance with the following requirements:

- a) All painting work shall be done subject to climatic conditions of the site as specified or directed by the Engineer
- b) If the equipment delivered to the site already painted but not generally in accordance with the requirements of this specification, the Engineer may at his discretion order any of the following actions:
 - If the paint already applied to the surfaces which will not be exposed to view in the finished installation is not considered to provide suitable protection to those surfaces, it shall be completely stripped off by an approved method and the surface cleaned down for repainting as specified. If the existing paint is considered to provide suitable protection, no further painting will be required for those surfaces.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

- If the paint already applied to exposed surfaces is considered to be a suitable base, it shall be cleaned down and one undercoat and two finishing coats as specified shall be superimposed.
 - If the paint already applied to exposed surface is not considered to be suitable base, it shall be completely stripped off by an approved method and the surface cleaned down for complete repainting as specified.
- c) All paints and other materials required for this installation shall be of the best quality of their respective brands. Unless otherwise specified, paints shall be ready mixed. Paints generally shall be prepared by the manufacturer for use without thinning or reducing unless otherwise specified.
- All materials shall conform to the relevant IS/ IEC / BS standard and shall be delivered to the site in unopened tins or bottles or in scaled packets, in each case bearing the manufacturer's name and the nature of the contents. The containers shall not be opened until just prior to their use.
- d) The finished colours required will be selected by the Engineer prior to the commencement of painting. Not more than 4 different colours will be chosen for main items of equipment but upto 12 different colours and shades may be considered for pipe work, vents, etc.

↳ **Surface**

All surfaces to be painted shall be thoroughly cleaned before painting, including all necessary power wire-brushing, scrubbing and scapping and the removal of the paint and grease spots, etc. so that metal surface shall be free from scale or rust. Surface to be painted shall be completely dry and the painters shall take all necessary precaution to ensure that freshly painted surface will remain free from condensation or other wetting until the paint has dried.

↳ **Application**

The painting shall be carried out by experienced tradesmen in accordance with best trade practice and shall afford first class finish within the limitations imposed by the nature of the surfaces of the items painted.

↳ **Heat Resistant Paints**

The paints applied to any surfaces, which may become hotter than the highest temperature for which normal paints are suitable, shall be heat resistant to a degree commensurate with the highest temperature they may be called upon to withstand.

All surfaces shall have one priming coat applied. Steel and iron shall be primed with a rust inhibiting primer and galvanized surface shall be primed with an etching primer. A second priming coat shall be applied to all surfaces which will be covered by insulation or attached equipment and to all other surfaces where the Engineer considers the first primer has proved inadequate for its purpose.

↳ **Steel Work Equipment and Pipelines**

One under-coat and two high glosses plastic paint coats shall be applied to all surfaces not covered by insulation or attached equipment. Areas of equipment or piping which may be inaccessible after installation, shall be painted beforehand where possible. Valves and other fittings shall be painted unless otherwise directed by the Engineer.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

↳ Sign Writing

All major items of equipment shall be identified with approved names and / or numbers, of suitable size in proportion to the size of the respective items. Pipeline shall also be marked with directional arrows, of suitable size, at regular intervals.

5.11 Name Plates and Handbooks

All equipment or parts of the equipment shall bear name plates for complete identification as per standard international practices, IEC standards and other standards mentioned in the tender documents. Handbook and circuit diagrams clearly and lucidly explaining the generator and control circuit systems shall be supplied by the Contractor.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

Annexure – ‘E’ to Technical Specifications

6 (a) WATER METERS

Water meters of approved make and design shall be supplied for installation at suitable locations. The water meters shall meet with the approval of client. Suitable valves and chambers or wall meter box to house the meters shall also be provided along with the meters.

The meters shall conform to Indian Standard IS: 779 and IS: 2373. Calibration certificate shall be obtained and submitted for each water meter.

Provision shall also be made to lock the water meter. The provision shall be such that the lock is conveniently operated from the top. Where the provision is designed for use in conjunction with padlocks, the hole provided for padlocks shall be a diameter not less than 4mm.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

Annexure – 'F' to Technical Specifications

6 (b) FUNCTIONAL SPECIFICATION FOR CHAIN PULLEY BLOCK

6.1 GENERAL

This specification along with data sheets, other specifications & attachments to inquiry/ order describes and constitutes the minimum requirement for Chain Pulley block with or without trolley for Hazardous area application.

The intent of these requirements is to supplement the requirements as given in data sheets, other specifications and other applicable standards / codes referred to in data sheets / specifications.

Contractor and vendor shall make all possible efforts to comply strictly with the requirements of this specification and other aforesaid specifications / attachments to inquiry / order and no deviation and exception from this specification shall be permitted without written approval of Company.

In case any deviations are considered essential by vendor, these shall be separately listed in vendor's offer titled as "List of deviations / exceptions to the inquiry document" , supported with proper reasons for the deviation for Company's considerations. Any deviation indicated elsewhere, but not listed in the deviation list shall not be considered applicable.

Except as specified herein, the chain pulley block shall be designed, manufactured, tested and supplied in accordance with data sheets / specifications / applicable standards / codes(latest edition). In the event of any contradiction, the following order of precedence shall govern: -

- Equipment data sheet
- Job specification / This specification
- Other reference specifications / attachments.
- International standards / codes as applicable.

As a general rule, the most stringent requirement shall apply.

Contractor / vendor shall seek Company's approval regarding such features which are not specified by Company but job requirements call for purchaser decision on these matters.

Compliance with this specification shall not relieve Contractor / vendor of the responsibilities of furnishing equipment and accessories / auxiliaries of proper design, materials and workmanship to meet the specified start up and operating conditions.

In case Contractor / vendor considers requirement of additional instrumentation, controls, safety devices and any other accessories / auxiliaries essential for safe and satisfactory operation of the equipment, he shall recommend the same along with reasons in a separate section along with his offer and include the same in his scope of supply.

Chain pulley block vendor / manufacturer shall have adequate engineering, manufacturing and testing facilities conforming to national / international standards / codes.

The chain pulley block offered shall be from a regular and established manufacturer of chain pulley blocks.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

The chain pulley block offered shall be from the existing regular manufacturing range of chain pulley block vendor / manufacturer and already type tested at either manufacturer's works or outside. Vendor's / manufacturer's catalogue and general reference list shall be furnished along with the offer.

Chain pulley block vendor / manufacturer shall assume responsibility for satisfactory performance of the equipment for the specified service.

Chain pulley block and all auxiliaries shall be suitable for the specified area classification.

Chain pulley block vendor / manufacturer shall not offer any alternative designs.

Special tools and tackles required either for installation / erection or operation and maintenance of the chain pulley block shall be included in vendor's scope of supply.

6.2 CODES AND STANDARDS

The following latest edition codes, standards and recommended practices shall govern:

IS:3832 Specification for Hand operated Chain Pulley Blocks.

IS:2429 Specification for Round steel short link chain.

IS:6216 Specification for Short link chain, grade T(8) calibrated.

IS:8610 Specification for Point hook with shank up to 25 Tons trapezoidal section.

Other international standards may also be acceptable subject to their being equivalent or superior with prior approval of Company.

For provisions not covered by the above codes & standards, applicable engineering practices & norms shall govern.

6.3 TECHNICAL REQUIREMENTS

Design and manufacture of chain pulley block with or without trolley shall be consistent with capacity, lift, headroom and other parameters as specified in the data sheets.

In design of chain pulley blocks, care shall be taken for following features.

- Minimum effort to lift a specified load.
- Self-braking system for holding the load in any position.
- Even loading of bearings.
- Ease of installation and maintenance.
- Compact design.

For chain pulley blocks operating in hazardous area, the materials for non-lubricated rubbing parts shall be of non-sparking type(non-ferrous).

The suggested materials for such components are as follows:

Ratchet wheel, load chain wheel, hand chain wheel, chain guides for lifting mechanism	:	Solid construction in Phosphor bronze or Gun metal or brass.
Rims of un-gearred runners, geared runners, hand chain wheel and hand chain wheel guides for trolley mechanism.	:	Phosphor bronze or Gun metal or brass.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

Load hook	Forged brass / Aluminium bronze
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All materials used in construction of different components shall individually conform to IS: 3832.

6.3.1 Frame

The frame shall be designed for proper strength built from steel plates with bolted / welded construction.

6.3.2 Gear

Chain pulley blocks shall be supplied with helical or worm gear. The gear shall be designed for surface durability. All gears shall be machine cut from alloy steel and case hardened. In case of enclosed gearing, means shall be provided for ample lubrication.

6.3.3 3.4 Load Brakes

Chain pulley block shall be provided with an automatic mechanical Ratchet and Pawl type load brake which will prevent self lowering of the load and sustain and hold the load in all working positions. The load brake shall allow smooth lowering of the load without serious overheating which may impair efficient working of the block. The Pawl & Ratchet shall be made of steel hardened and tempered to provide satisfactory degree of wear resistance. The hardness of Pawl tip and Ratchet shall not be less than 40 and 30 HRC respectively.

6.3.4 3.5 Bearing

Only antifriction bearing shall be used. All the bearing shall be adequately lubricated type and arrangement of lubrication shall be clearly indicated on the cross section drawings.

6.3.5 3.6 Hooks

3.6.1 The hooks(top and bottom) shall conform to IS: 8610. The bottom hook block shall be provided with thrust bearing to enable it to free swivel in the loaded condition without twisting the load chain. The top hook if required to swivel shall also be provided with thrust bearing. Hooks shall be provided with safety latches to prevent accidental unhooking.

3.6.2 Suspension fitting other than hook shall be of sufficient strength to afford a static factor of safety of not less than 4.

6.3.6 Load Chain

The load(link) chain shall be conforming to minimum Grade 80 of IS: 6216. The chain shall be pitched and polished.

3.7.1. Hand Chain

The hand chain shall be conforming to grade 30 of IS: 2429 (Part-II). The chains shall be pitched & polished. The chain link dimension shall be conforming to 6.3 mm nominal diameter chain of IS:2429 (Part-I). The length of chain shall be such that the lowest point of loop shall be 0.4 meter above the operating level.

6.3.7 Chain Wheel

- o Wheel for load chain shall be made of material suitable for use with load chain employed and be of adequate strength and shall be designed to ensure effective operation.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

- Wheel for hand chain shall be provided with flange.
- Wheels shall be provided with guides to prevent sagging of chain.

6.3.8 Idler Wheel

The chain pulley blocks shall be provided with idler wheels so shaped as to avoid twisting of the chain when passing round. The pitch diameter of the idler wheels shall not be less than 16 times of size of the chain.

6.3.9 Trolley

The trolley for the chain pulley block shall be geared type, fabricated construction, 4 wheeled, driven by hand chain and shall have provision for mounting the chain pulley block.

Trolley shall be designed to suit the suitable joist size and the hoisting capacity.

6.4 INSPECTION AND TESTING

- Unless otherwise specified all the chain pulley blocks shall be stagewise inspected and witness tested by third party inspection agency(at Contractor's cost). However, Company reserves the right to depute its authorized representative in addition to third party inspection agency.
- As a minimum, tests shall be carried out as specified in the data sheets and elsewhere (if any). However, Company reserves the right to witness all mechanical and performance tests.
- Contractor / vendor shall give at least 15 days notice prior to commencement of testing.
- Vendor shall notify his sub-vendor of Company's inspection and testing requirements.
- All inspections shall be regarded as check-up only. However acceptance of shop test shall not absolve / relieve Contractor and vendor from any of their responsibilities in any way, whatsoever.
- All controls and safety devices shall be tested for satisfactory operation and settings.
- Company's representative shall have access to vendor's / manufacturer's shop as well as to sub-vendor's shop at all times during manufacturing of the equipments and vendor / manufacturer shall provide all requisite facilities including necessary monitoring and measuring devices to Company's representative for carrying out satisfactory inspection and witnessing the tests.
- Equipment shall be subjected to stagewise inspection and testing at vendor's / subvenders works by third party inspection agency and / or by Company's authorized representative. Vendor shall furnish schedules for all inspections and tests to be conducted on all the equipment and auxiliaries in his scope of supply in a single document titled 'Inspection & Test Plan' within four weeks of placement of purchase order / letter of intent for Company's review and approval. The extent of Company's participation and schedule of submission of inspection and test procedures as specified in inquiry / order shall also be reflected in 'Inspection and Test Plan'.
- Each chain pulley block shall be subjected to one and a half times the safe working load through a length of lift which will ensure that every part of the block mechanism and each tooth of gears come under load. The trolley shall be tested for smooth operation when loaded.
- Certificate of test and examination shall be issued with all the chain pulley giving the following information's.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

- i) Safe working load.
- ii) Range of lift.
- iii) Load chain size and grade.
- iv) Proof load applied.

6.5 GUARANTEE / WARRANTY

- Contractor and equipment vendor shall guarantee all equipments and components (including all auxiliaries) supplied in respect of design, materials and fabrication and / or workmanship for 24 months from the date of supply or 12 months from the date of successful commissioning, whichever is later.
- If any defect or mal-performance occurs during the guarantee period, Contractor and equipment vendor shall make all necessary alteration, repairs, and replacements free of charge.
- Company's approval of the equipment design shall not relieve Contractor and equipment vendor of their responsibilities to ensure satisfactory performance of the items supplied.
- Contactor and equipment vendor shall guarantee that all materials used are new, satisfactorily passed through acceptance procedure and is acceptable in quality, form and appearance.
- Equipment vendor shall be responsible for overall performance of the equipment

6.6 PROTECTION AND PAINTING

- All exposed carbon steel parts to be painted shall be thoroughly cleaned from inside and outside to remove scale, rust, dirt and other foreign materials by wire brushing and sand blasting, as applicable. Minimum acceptable standard in case of power tool cleaning shall be St. 3 and in case of blast cleaning shall be Sa 2 1/2 as per Swedish Standard SIS: 055900(latest edition).
- Non-ferrous materials, austenitic stainless steels, plastic or plastic coated materials and insulated surfaces of equipment not be painted.
- Stainless steel surfaces both inside and outside shall be pickled and passivated.
- Machined and bearing surface shall be protected with varnish or thick coat of grease.
- Depending on the environment, following primer and finish coats shall be applied.

Environment		Description	
1	Normal Industrial	Primer	: 2 coats of Red oxide zinc chromate, each 25 microns (min.) thick.
		Finish	: 2 coats of Synthetic enamel, each 25 microns(min.) thick.
2	Corrosion Industrial	Primer	: 2 coats of Epoxy zinc chromate each 35 microns(min.) thick.
		Finish	: 2 coats of Epoxy high build paint, each 100 microns(min.) thick.
3	Coastal and Marine	Primer	: 2 coats of High build chlorinated rubber zinc phosphate each 50 microns(min.) thick.
		Finish	: 2 coats of Chlorinated rubber paint each 35 microns(min.) thick.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

4	All environments (Temp. 80-250°C)	Finish	:	2 coats of Heat resistant Aluminium paint suitable for 250°C each of thickness 20 microns.
5	All environment (Temp. 250-400°C)	Finish	:	2 coats of Heat resistant Aluminium paint suitable for 400°C each of thickness 20 microns.

(All values refer to dry film thickness)

- The colour of finish coat shall be intimated to vendor after placement of order.

6.7 PACKAGING AND IDENTIFICATION

- All packaging shall be done in such manner as to reduce the volume. The equipment shall be dismantled into major components suitable for shipment and shall be properly packed to provide adequate protection during shipment. All assemblies shall be properly match marked for site erection.
- Attachments, spare parts of the equipment and small items shall be packed separately in wooden-cases. Each item shall be appropriately tagged with identification of main equipment, item denomination and reference number of the respective assembly drawings.
- Detailed packing list in water-proof envelope shall be inserted in the package together with equipment.
- Each equipment shall have an identification plate giving salient equipment detail / data, name of manufacturer, make / model, equipment number, year of manufacture etc.

6.8 SPARE PARTS

- Contractor / vendor shall submit recommended list of spare parts with recommended quantities for one year as well as first two years of operation of the equipment alongwith the itemized price list for all parts. Proper coding and referencing of spare parts shall be done so that later identification with appropriate equipment will be facilitated.
- Recommended spares and their quantities should take into account related factors of safety, equipment reliability, effect of equipment downtime upon production, cost of parts and availability of vendor's service facilities around proposed location of equipment.
- Vendor shall also submit a list of recommended commissioning spares with quantities and the itemized prices. However supply of commissioning spares shall be in Contractor's / vendor's scope of supply without any extra cost to Company.

Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

Annexure – ‘G’ to Technical Specifications
List of Approved Manufacturers

EMPLOYER'S REQUIREMENTS
APPROVED MANUFACTURERS/SUPPLIERS

All materials and products shall conform to the relevant standard specification, BIS codes and other relevant codes etc. and shall be of make as approved by Engineer.


The list of approved makes for products and materials is given below. Other equivalent manufacturers may also be considered with prior approval of the Engineer, if found conforming to all standards. Such requests should be made with all documents to the Engineer at least 45 days before the material is required and any order shall be placed only after receiving the written approval of the Engineer.

S.No.	Details of Materials / Products	Manufacturer's Name
1	Cement	ACC, Ultratech, Gujarat, Ambuja, Grasim, JK Lakshmi, JSW, Lafarge
2	Reinforcement Bars	SAIL Plants, Rashtriya Ispat Nigam Ltd. (Vizag Steel Plant, Andhra Pradesh), Tata Steel (Jharkhand), Ispat Industries (Maharashtra), JSW Steel (Karnataka), JSP, Essar Steel (Gujarat), Shyam Steel (Durgapur), Monnet Steel, and any other integrated steel plant as per Ministry of Steel's definition.
3	Epoxy	FOSROC, SIKA QUALCRETE, Araldite, BASF, Kunal Conchem, CHRYSO, Don Chemicals, STP, Cleantech SA, TAM, CICO, MC-Bauchemie, Pinnacle, Fibrex, MYK Schomburg, Parex Group (Lanko), Hindustan Silicate & Chemical, ACC
4	Expansion Joints	Kantaflex, Kanta, Maruti Techno, Prequalified Manufacturers as per RDSO's latest approved list or as approved by DMRC.
5	Admixtures	FOSROC, MBT, MC Baucheme, Sika, APEX, Pidilite, Polygon, CHRYSO, Choksey, STP, MYK Schomburg, BASF, MAPEI, Kunal Conchem, Durabuild, Conproof, CAC, H & R Johnson, Asian Lab., TAM, Adoadditives, STP, CICO, Fairmate, ATPL, Pinnacle, Rheoplast, Grace Construction, ACC, Hindcon, DON
6	Pile Integrity Testing Agency	CBRI, FUGRO- KND, Pile Dynamic, AIMIL, Geo dynamic, CEG Test House, EMC India, Mythcon, ATL, AVANTECH
7	Anchor Fastener	HILTI, FISHER, Canon, Pooja Forge, AXEL Industries, Panchsheel, Pioneer Nuts and Bolts (TUFF Brand), BOUN Group, MUNGO, LPSEJOT


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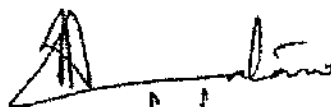
Contract No: CC-100: Water Supply Arrangements for under construction underground portion of Line-6-Ext (From Yamuna Bank - RSS to Jama Masjid) and construction of UG reservoir & pipe network at Yamuna Bank - RSS and related Electrical works of Delhi Metro Project of Phase-III.

S.No.	Details of Materials / Products	Manufacturer's Name
8	Structural Steel	TATA, SAIL, ESSAR, Maharashtra Pipes, Jindal Steel & Power Ltd., JSW, K.L. Steel, Steel Works & Power Engineers, SKS Ispat & Power, Shanti Steel
9	Stainless Steel	Jindal, SAIL or approved equivalent
10	Pre-stressing Strand (LRPC)	TATA SSL Ltd, USHA Martin, (DP wires, Ramsarup Nirmaan only if first two supplies are short)
11	Pot/Elastomeric Bearings	Prequalified Manufacturers as per RDSO's latest approved list or as approved by DMRC.
12	Horizontal Tie Bars/Shear Bars	BB Bars System, BBV Systems or approved equivalent
13	HDPE Sheathing	Rex Polyextrusion, Gwalior Polypipes Ltd, Kataria Sheathing, M/s Tirupati, M/s Dynamic Prestress
14	Formwork Release Agent	FOSROC, MBT, MC Baucheme, Ado Conmat, CICO, CHRYSO, Choksey, BASF, Adoadditives, STP, DON
15	Prestressing System	Freyssinet, BBR, VSL, Dynamic, Killick Nixon, Tensacciai (India Ltd.), JK Prestressing, Usha Martin, Posten, VSIL, Wartex Systems
16	Reinforcement Couplers	Dextra, Moment, Arise, Hi-Tech, G.Tech, Kridhan, JB Engg., Unitech
17	Hollow Sections, Pipes	Surya Pipes, Hi-Tech Pipes, JSW, JSPL, Bihar, Ravindra Tubes, Garg Ispat Udyog
18	Drainage Pipes	Tirupati Plastomatics, Duralline, REX, STIPL
19	Acrylic Textured Coatings	Spectrum, Renova, Wallz, Surfa Nova, Jotun, Asian Paints
20	Non shrink Grout	Fosroc Chemical (India), SIKI BASF, ELCHEM, MBT, Sika, CHRYSO, Don, Choksey, Cleantech IR, Adoadditives, TAM, STP, CICO
21	Bonding Coat	CICO, FOSROC, Sunanda speciality coating Pvt. Ltd., BASF, CHRYSO, TAM, DON
22	Polysuphide Sealant	CICO, Pidilite, BASF, FOSROC, CHRYSO, STP, SIKI, Fairmate, DON
23	Steel Structural Fasteners	Pooja Forge, Sundram Fasteners, Unbrako, Nelson, Panchsheel, LPSEJOT
24	Paints	Berger, Johnson Nicholson, Nerolac, Asian, Akzo


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S.No.	Details of Materials / Products	Manufacturer's Name
		Nobel, PPG, Jotun, Shalimar
25	Micro Silica	Sika, Elkem, FOSROC, MAPEI, Comiche, Star Silica, TAM, CALIPAR, CICO, Rockfit
26	Fire Resistant Paints	Akzo Noble, PPG, Jotun
27	External Acrylic Emulsion	Berger, Apex, Asian, Nerolac, Jenson & Nicklson
28	Integral Crystalline Waterproofing Method	Kryton Buildmat Co. (Pvt.) Ltd., Penetron, Vandex International Ltd., BASF, Chryso, XYPEX, Normet India, DON
29	Water stopper/Bar	Kanta Rubber, Greenstreak, Maruti, Duron, Deep-Jyoti Rubber
30	Liquid polymer membrane waterproofing	INTEGRITANK, BASF, MAPEI, PIDILITE, CICO, Normet India, DON
31	Curing Compound	Clean tech concure, SINAK, FOSROC, Adoadditives, TAM, STP, CHRYSO, CICO, DON
32	Polycarbonate Sheets	M/s Gallina Acroplus, Coxwell, Poly U, Fabric, SABIC, DANPALON
33	Fly Ash	Thermal Plants, Ashcrete, Ultra Pozz, Star Pozz (the Fly Ash shall be as per our specifications)


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Pre- Bid Queries of Contract No. CC:100

Sl.No.	Description	Query asked by Tenderer	Reply by DMIRC
1	A. TECHNICAL SPECIFICATION -VOLUME 4	Please provide the list of DMRC approved makes for various items involved in this tender. Also, please confirm that in case for any of the required items, no makes are indicated in the list, we shall supply the such item from any of the reputed manufacturer with DMRC approval.	List of approved manufacturer is enclosed herewith Addendum-1 as Annexure-G to Technical Specifications.
2		We note that reference has been made for Annexure-A: SSPC-PAZ at page 103 under index of "Specification for Civil Work". However, this Annexure is not enclosed with tender documents. Please provide the same for our review.	Annexure-A to Technical Specification is now enclosed herewith Addendum-1
3		We refer to serial No.-3 – Pipe & Fittings of "Specification for civil works" at page No.-51 and note that specifications for DI Butterfly Valve, Gun Metal Ball Valve and Air Release Valve (ARV) has not been provided, whereas these items are appearing in the BOQ furnished with the tender specification. Please provide the specification and material of construction for these items.	Specifications for DI Butterfly Valve, Gun Metal Ball Valve and Air Release Valve are enclosed as - Annexure -B to Technical Specification alongwith Addendum-1
4		We refer to "Electrical Specification" and note that while specification for clear water submersible pumping set has been furnished in the tender specification, specification for other pump specified in the BOQ, such as Horizontal Centrifugal Pump has not been furnished. Please provide the specification for Horizontal Centrifugal Pump. Also, we note that at page No.-72 of this specification you have furnished details of inline Booster Pumps at Munirka. Please clarify our scope with regard to same. Also, the quantities of various items furnished therein such as motors, cables, instruments etc. has not been indicated in the BOQ provided by you. Please clarify.	Technical Specification of Horizontal Centrifugal Pump is enclosed as Annexure-C to Technical Specification alongwith Addendum -1. Inline Booster Pumps are out of scope of this work. The pump set in it-self will cover the complete set including motors, cables, instrument etc.
5		We also note that supply of DG Set is also included in our scope as specified in the BOQ. However, the specification for the same has not been furnished in the Electrical Specification provided with the tender specification. Please provide the specification for DG Set.	Specification of DG Set is enclosed as- Annexure-D to Technical Specification alongwith Addendum-1
6		We refer to the BOQ furnished with the tender specification and request you to note as follows:	
		(a) Referring to Schedule-A-Serial No.-23, we note that enclosed type water meter (bulk type) has been specified. However, the technical specification of same ,has not been furnished in the tender specification. Please provide the same.	Specification of enclosed type water meter is enclosed as Annexure-E to Technical Specification alongwith Addendum -1

	<p>(b) Referring to Schedule-A-Serial No.-11 & 17 for DI End Cap, we note that quantity for same is mentioned as zero. Please clarify and confirm that the quantity for such items are zero.</p>	<p>Quantity of DI End Cap will remain zero as per design; we are not providing any end section. However rate to be provided.</p>
	<p>(c) We refer to Schedule-A- Serial No. – 31, 32, 33 and 34 for “Joint filling, Gasket, Lubricant, Nut bolts with washer respectively and note that supply of these items are also included in our scope. Please furnish the details of these items since supply of these 4 items are included in our scope.</p>	<p>Joint filling, Gasket, Lubricant; Nut bolts with washers shall be in contractor’s scope of work. These are the general items used for supplying, jointing and fixing of pipes. These items shall be provided in sufficient numbers so as to fully meet the requirement of the work.</p>
	<p>(d) We refer to Schedule-B-1 (Sub Head -2) Serial No.-H and note that Chain Pulley Block for 1 ton capacity and 2 ton capacity has been specified while the quantity of 1 ton capacity has been furnished as 1 No. the quantity for 2 ton capacity has been furnished as zero, please clarify. We also request you to furnish Technical Specification and MOC for these Chain Pulley Block required under the scope.</p>	<p>Only 1 no. of 1 ton capacity Chain Pulley Block will be provided, specification for the same is enclosed as Annexure - F to Technical Specification alongwith Addendum -1</p>
<p>2</p>	<p>B. GENERAL CONDITIONS OF CONTRACT (GCC)- VOLUME 2</p>	
	<p>1</p>	<p>Clause 4.18 of GCC/page 23 of 66 – We note that employer shall provide water, electricity and gas for the works, wherever required and feasible. We presume same shall be provided free of charge. We also presume that wherever possible, Land for storage, fabrication and our site office shall be also be provided by you at various locations free of cost.</p>
	<p>2</p>	<p>Clause 1.1.6 of GCC/ page 48 of 66 – We understand that prorata 80% interim payment shall be made against supply of materials, 15% shall be made on Erection of same and 5% on testing & commissioning. Please confirm. Please inform the contact details of your personnel who can be contacted for our site visit.</p>
	<p>3</p>	<p>The existing tender conditions shall prevail. The existing tender conditions shall prevail. Office of CPM-8 may please be contacted for purpose of site visit.</p>